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Compliance is Mandatory

REQUIREMENTS AND LIMITIATIONS FOR EXPOSURE TO REDUCED ATMOSPHERIC PRESSURES

Responsible Office: Space Life Sciences

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Change History Log

Revision	Date	Originator	Description of Changes
Baseline	April 2009	R. MARTEL	Initial Release

P. PREFACE

P.1 PURPOSE

To define the requirements and limitations that minimizes the risk of decompression sickness in personnel flying in NASA aircraft and working in hypobaric chamber environments.

P.2 APPLICABILITY

This JPR is applicable to the following affected organizations: Space Life Sciences, Flight Crew Operations and those personnel flying in NASA aircraft or training in hypobaric chamber environments including astronauts, test subjects, officers or employees of other Government agencies, and NASA contractor employees while performing such activities at NASA facilities under NASA cognizance. This procedural requirement excludes subjects in research tests conducted to investigate decompression sickness.

P.3 AUTHORITY

(All document citations are assumed to be the latest version unless otherwise noted.)

JPD 8080.4, Exposure to Reduced Atmospheric Pressures

P.4 APPLICABLE DOCUMENTS

(All document citations are assumed to be the latest version unless otherwise noted.)

a. JSC Procedural Requirements (JPR) 1700.1, "JSC Safety and Health Handbook."
b. JSC Procedural Requirements (JPR) 1830.3, "Limitations Applicable to Personnel Exposed to Diving."
c. JPD 1800.2, "Decompression Sickness."
d. JSC 20483, "JSC Committee for the Protection of Human Subjects Guidelines for Investigators Proposing Human Research for Space Flight and Related Investigations."

P.5 MEASUREMENT/VERIFICATION:

a. Measurement shall include the total number of incidents of aircraft cabin pressure loss.
b. Specific metrics of DCS to be measured is delineated in JPR 1800.3, Decompression Sickness Procedural Requirements.
c. Responsibility for collection of Aircraft Operations Division metrics lies with the Flight Crew Operations Directorate (FCOD). FCOD shall report these metrics to the Space Life Sciences Directorate. The Space Life Sciences Directorate shall perform annual reviews to ensure appropriate medical and administrative disposition.
d. Findings and recommendations of annual reviews shall determine adequacy of the Policy Directive and shall be used for future revisions of the JPD.

P.6 CANCELLATION / RESCISSION:

None.

Original Signed By:

Jeffrey R. Davis, MD
Director, Space Life Sciences

Distribution:
JDMS

1.0 RESPONSIBILITY

The Directors of Flight Crew Operations, Engineering, and Space Life Sciences are jointly responsible for ensuring compliance with the requirements of this JPR.

2.0 DEFINITIONS

2.1 Decompression sickness (DCS): A syndrome caused by a decrease in ambient pressure in living bodies when the tissues of the body contain an excess of physically inert gas.

3.0 REQUIREMENTS AND LIMITATIONS

Before exposure to hypobaric chamber environments, the requirements identified below, in addition to any contractual or administrative requirements, shall be satisfied (see Table 1 for minimum and maximum exposure limitations).

3.1 Table 1 lists pre-approved oxygen prebreathe protocols for exposures in JSC hypobaric chambers. For exposures and durations not listed, the Extra Vehicular Activity Integrated Product Team shall recommend and approve prebreathe requirements.

3.2 A period of 24 hours shall have elapsed before re-exposure to reduced pressures below 5.4 pounds per square inch absolute (psia) or above 25,000 feet mean sea level (MSL) in hypobaric chambers. (This constraint does not apply to research subjects undergoing multiple exposures to various pressure levels during a test, provided the appropriate Committee for Protection of Human Subjects has approved the test protocol, and the test subject maintains his or her denitrogenation level throughout the procedure.)

3.3 Dry runs in preparation for a test or training exercise shall be conducted with breathing air at approximately sea level conditions unless the appropriate safety measures associated with reduced pressure or oxygen enrichment are utilized.

3.4 Prebreathing greater than 95 percent oxygen prior to chamber decompression below 7.4 psia (above 18,000 feet MSL) pressure level shall be accomplished in accordance with Table 1.

3.5 In no event shall the maximum exposure time be exceeded for the corresponding prebreathe duration and the respective minimum pressure (altitude) as specified in Table 1. If chamber activities from leaving site pressure to reaching site pressure are not completed within the timeframe, the test or training exercise shall be terminated and the chamber recompressed to site pressure.

3.6 Sufficient partial pressure of oxygen shall be maintained throughout the chamber decompression cycles to maintain the prebreathe status and to maintain alveolar oxygen above 75 torr, a 6,000-feet MSL altitude equivalent.

3.7 The following limits to breathing 100 percent oxygen apply:

3.7.1 No more than 9 hours breathing 100 percent oxygen at sea level pressure or sea level plus 1.5 psia when prebreathing or conducting a dry run in a pressure suit shall be permitted due to oxygen toxicity effects where this is the only exposure to enriched oxygen in a 48-hour period.

3.7.2 No more than 6 hours breathing 100 percent oxygen at sea level pressure or sea level plus 1.5 psia when prebreathing or conducting a dry run in a pressure suit shall be permitted due to oxygen toxicity effects where this is the only exposure to enriched oxygen in a 24-hour period and consecutive daily exposures shall not exceed 5 days.

3.8 Following an altitude/vacuum chamber flight above 25,000 feet MSL, commercial or T-38 flights with cabin altitude $\leq$ 10,000 feet MSL (T-38 FL 250) can be performed after a 12-hour surface interval. There are no flight restrictions after a 24-hour surface interval. The above applies to all personnel with no symptoms of decompression sickness. Should any symptoms arise during or after a chamber flight, personnel shall only resume flying after complying with procedures listed in JPD 1800.2, "Decompression Sickness."

3.9 Hypobaric chamber flights and aircraft operations after compressed gas diving are governed by the specific limitations found in JPR 1830.3.

3.10 For suited Extravehicular Mobility Unit (EMU) operations, the following additional requirements apply:

3.10.1 The oxygen/nitrogen mixture shall be maintained such that the alveolar oxygen remains above 75 torr, a 6,000-feet MSL altitude equivalent.

3.10.2 Dry runs in preparation for a test or training exercise shall be accomplished during suited prebreathe time. Suit pressure shall be maintained within 1.5 psi of sea level pressure unless the appropriate safety measures associated with increased pressure or oxygen enrichment are utilized.

3.11 When loss of aircraft pressurization occurs, the following additional requirements apply:

3.11.1 In the event of exposures to atmospheric pressure or cabin altitudes greater than 30,000 feet, personnel shall immediately go on 100 percent oxygen and the aircraft shall descend to an altitude of 10,000 feet cabin pressure altitude or lower as soon as possible and land as soon as practical at the nearest civilian or military installation with appropriate aircraft support services. Personnel shall not fly in civilian or military aircraft

as crew or passengers for 12 hours following the depressurization. Consultation shall be obtained from Duty JSC Flight Surgeon upon landing.

3.11.2 In the event of exposures to atmospheric pressure or cabin altitudes greater than 25,000 feet MSL to less than or equal to 30,000 feet MSL, personnel shall immediately go on 100 percent oxygen and the aircraft shall descend to an altitude of 10,000 feet cabin pressure altitude or lower as soon as possible. For the 12 hours following depressurization, flight activities shall be restricted to cabin altitude of 10,000 feet MSL or less. This allows continuation of flight in T-38 at 10,000 feet MSL or less, flight in commercial aircraft pressurized to 8,000 feet MSL, or flight in another T-38 with working pressurization system to cabin altitude 10,000 feet MSL or below which is 25,000 feet MSL or less aircraft altitude.

3.11.3 When an occupant of an aircraft is observed or suspected to be suffering from the effects of decompression sickness, 100 percent oxygen shall be administered to all occupants. The pilot shall immediately descend to the lowest practical altitude, preferably below 10,000 feet MSL, and land at the nearest civilian or military installation suitable for safe landing. Upon landing, Duty JSC Flight Surgeon shall be notified of decompression sickness episode as soon as possible. Personnel shall only resume flying after complying with procedures listed in JPD 1800.2, "Decompression Sickness."

3.11.4 The pilot shall report any cabin depressurization or occurrence of decompression sickness in accordance with current Aircraft Operations procedures.

3.12 Personnel who are known to be pregnant or who believe they may be pregnant shall not take part in hypobaric chamber flights.

4.0 RECORDS AND FORMS

4.1 Records retained by JSC Space Life Sciences

Records	Who Maintains	Retention Schedule
Hypobaric Training Records	Clinical Services Branch, Human Test Support Group	**Schedule 8, Item 101, Permanent**. Cut off records at close of program/project or in 3-year blocks for long term programs/projects. Transfer to records center storage. Transfer to National Archives 7 years after cutoff. Special media records will be transferred in accordance with 36 CFR S 1228.270 (electronic records), 36 CFR S 1228.266

		(audiovisual records), 36 CFR S 1228.268 (cartographic and architectural records), and/or current transfer instructions specific to individual formats.
Medical Records - Astronauts	Clinical Services Branch	Schedule 8, Item 57: **PERMANENT**. RETIRE RECORDS TO FRC WHEN ASTRONAUT IS SEPARATED FROM THE PROGRAM/AGENCY. TRANSFER TO NARA WHEN 30 YEARS OLD.
Medical Records – Test Subjects	Clinical Services Branch, Human Test Support Group	**Schedule 8, Item 57**, DESTROY 75 YEARS AFTER BIRTH DATE (DOB), OR 60 YEARS AFTER DATE OF EARLIEST DOCUMENT IN THE FOLDER IF DOB CANNOT BE ASCERTAINED, OR 30 YEARS AFTER CONTRACT HAS BEEN COMPLETED/TERMINATED WHICHEVER IS LATER.
Accident/Mishap Reporting	Safety and Mission Assurance Directorate	Schedule 1, Item 121B. RETIRE TO FRC WHEN 4 YEARS OLD. DESTROY WHEN 20 YEARS OLD.

4.2 Forms used in this process

NF 1391, Aircraft Flight Mishap Checklist

NF 1627, NASA Mishap Report

JSC Form 340, JSC Occupational Injury/Illness Report

TABLE 1: ACCEPTABLE CREW MEMBER EXPOSURES

Minimum Pressure on Body (psia)	Maximum Altitude (feet)	Maximum Exposure Time From Leaving Site Pressure to Returning to Site Pressure (minutes)	Prebreathe Time Requirement (minutes)
7.4	18,000	Unlimited	None
6.5	21,000	>30	90
5.4*	25,000	35	30
5.4	25,000	>35	210
4.4	30,000	15	30
4.4	30,000	30	60
4.4	30,000	>30	240
4.3**	30,500	30	60
4.0**	32,000	>30	240
3.5**	35,000	90	180
3.5***	35,000	30	30

Note: Any denitrogenation protocol involving staged decompression that has been verified and approved for flight shall be used for hypobaric exposure of trainees or test subjects.

Specific NASA Type 1* and Type 2*** Hypobaric Chamber Flight used in Physiological Training, which are acceptable protocols.

** For use only with EMU training and testing activities where a brief transition of less than 5 minutes total from nominal 4.3 – 4.0 psia to 3.5 psia is allowed.